Mobile laser scanning with iPad Pro LiDAR

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Abstract

The possibilities to capture three-dimensional point clouds of forest ecosystems from the ground keep expanding. During the last 20 years, terrestrial laser scanning (TLS) has been the most investigated remote sensing approach for acquiring information of forests and individual trees. The results of such research showed a high estimation accuracy for tree positions, volume, diameter at breast height (DBH), height and other biometric parameters. An alternative approach is mobile laser scanning (MLS) which can be placed on a car/train or carried/hold by an operator, with the advantage of being fast and convenient data acquisition.

Currently, an additional approach to conduct mobile laser scanning implements smartphones or tablets with embedded LiDAR sensor. The recent iPad Pro and iPhone 12 Pro are equipped with both high-resolution RGB cameras and LiDAR sensor. In this study, we compared the performance of such a mobile device on eight research plots with 25 m by 25 m dimensions. Altogether, 268 trees were included in the analyses (DBH > 7.0 cm). As reference point clouds we have used TLS (FARO). All tree positions on research sites were measured traditionally using total station and DBH was measured by measuring tape.

Tree detection rate ranged from 100% to 90.6% for TLS and from 87.5% to 64.5% for iPad Pro. DBH estimation root mean square error (RMSE) of TLS and iPad ranged from 1.0 cm to 2.0 cm and from 2.6 cm to 3.4 cm, respectively. And relative RMSE ranged from 3.7% to 6.4% and from 8.6% to 12.9%. The correlation between reference and estimated DBH was r2 = 0.996 for TLS and r2 = 0.973 for iPad Pro.

Results showed high potential of iPad Pro equipped in LiDAR sensor for further usage within the forest inventory. Currently, the data acquisition was done without using the Simultaneous Localization and Mapping (SLAM) algorithm. We believe that the results are going to be even more accurate and reliable with implementation of robust SLAM algorithms.

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